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ABSTRACT

This evaluation study examined the implementation of the Marine Science Young Scholars Program, which provided 32 gifted deaf and hearing-impaired adolescents with a 4-week summer enrichment program in 1988 and 1989. The instructional program: used a cognitively based curriculum; included labs, lectures, and field experiences; promoted one-to-one interaction; required active learning; and included the topics of the scientific method, the ethics of science, and career awareness. Students and staff were interviewed, pre- and post-attitude questionnaires were completed, and participant observation was conducted. Results are reported for recruitment and selection, instructional methods, affective objectives, project management and staffing, and adequacy of facilities. Generally, the students' affective response to the program was positive, with the academic and nonacademic programs both considered to be very strong. Student and staff recommendations for program improvement were used as the basis of a set of 50 guidelines, including: start recruitment early; use active learning and small group exercises; find deaf professionals to serve as role models; get captioned films and videotapes; provide a variety of well-organized and pre-planned recreational activities; and provide ongoing feedback to the director through an independent evaluator. (Includes 15 references.) (DB)

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GUIDELINES FOR SCIENCE PROGRAMS FOR HEARING IMPAIRED ADOLESCENTS

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In recognition of hearing impaired students lack of access to in-depth pre-college science programs and the under-representation of hearing impaired individuals in science careers, the National Science Foundation (NSF) funded the "Marine Science Young Scholars Program" which was designed to serve gifted deaf and hard of hearing adolescents from across the United States (Keller 1988; 1989). The students attended a four week program in the summer of 1988 or 1989 at Wallop's Island off the coast of Virginia. The NSF requested that the learning environment reflect students' interests so that they would see their participation as worthwhile and feel intellectually challenged. The instructional program used cognitive psychology as a framework for developing the curriculum (Linn & Songer, 1988; Eylan & Linn, 1987) and was designed to include labs, lectures and field experience; promote interaction on a one-to-one basis; require active learning; and include the topics of: the scientific method, the ethics of science, and career awareness.

A number of handbooks have been written to provide guidance for teaching science to deaf students (Corrick, 1981; Keller, Pauley, Starcher, Ellsworth, & Proctor, 1983), however, few of these documents provide an empirical base for their recommendations. Empirical studies that have been done have tended to emphasize cognitive outcomes (Diebold & Waldron, 1988; Van Wagner, 1980) or behaviors exhibited by the deaf students during their science lessons (Elefant, 1979). Research on developing curricula and teaching methodologies for deaf students has largely focused on the areas of reading, language, and speech teaching (Moores, 1982). Traditional subject matter areas such as science have received little attention (O'Donnell & Adenwalla, 1989).

The purpose of the present analysis was to examine the implementation of the Marine Science Young Scholars program for hearing impaired adolescents and to identify those elements that contributed to or detracted from its success. The intent was to systematically investigate the students' and staff's experience

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in such a training program to provide empirical support for guidelines for teaching science programs. The approach to this study was designed to capture a picture of life in a science enrichment program for hearing impaired adolescents.

Methodology

Qualitative methods were used to collect and analyze the data (Goetz & LeCompte, 1984; Patton, 1980). Data were collected by means of participant observation, semi-structured interviews, document review, and questionnaires. Students and staff completed questionnaires concerning their background characteristics, interest and preparation in science, and experience with deafness. The interviews were semi-structured in that the same core topics were discussed with each individual. At the beginning of the first week, staff were interviewed to obtain more in-depth answers regarding their motivations for participating in the project, interest in science, knowledge of deafness, and work experience. All the students were interviewed at the beginning of the first week to obtain in-depth information about their expectations, interest in science, and career awareness and aspirations.

Two other rounds of interviews were conducted during each four week session. During the summer of 1988, all staff and students were interviewed at the end of the second and fourth weeks. During the summer of 1989, half the staff and half the students were interviewed at the end of the second week and the other half of both groups were interviewed at the end of the fourth week. The core topics that were included in these interviews included: descriptions of life in the program, attainment of affective objectives, communication methods and problems, and the adequacy of the facilities. Interviews with students in the second week started with an open-ended question: "Suppose I (the interviewer) am a new student in this program. I just arrived today. What do I need to know? What can you tell me about being in this program?" This question was then followed up with appropriate probes. Students interviewed in the fourth week were also asked to comment on their career aspirations and awareness.

Each interview lasted between twenty minutes and an hour and were conducted using Simultaneous Communication. The primary interviewer was a hearing person skilled in the use of sign communication who had passed the signed competency test at Gallaudet University at the "Advanced Plus" level. A deaf graduate student assisted in the interviews during the summer of 1988.

Participant observation of life in the program was conducted for three days at the beginning of the first week, two days at the end of the second week, and two days during the fourth week. The observer literally lived with the students and staff, going on field trips to the marsh and out on the boat, sitting in the classroom, eating meals together, and participating in the evening

recreational activities. Field notes were written on-the-spot or as soon after as possible (Goetz & LeCompte, 1984).

Students were asked to complete pre- and post-attitude questionnaires concerning their attitudes toward science, their perceptions of the program's impact on them, and their evaluation of the program's strengths and weaknesses. The staff also completed a written summative evaluation form to provide information about their perceptions of the program's strengths and weaknesses.

Subjects. The staff in 1988 consisted of the project director (who also served as an instructor), two instructors, three interpreters (one for four weeks, two for two non-overlapping weeks each), five counselors (three for four weeks; one for one week and one for two non-overlapping weeks), a student assistant, and an evaluator and an evaluation assistant. Additional persons served as guest lecturers on specific topics. All the staff (except the counselor who left after one week and the student assistant) were hearing. Only the interpreters knew sign language. Fourteen students attended the first session. Twelve of the students were profound to severely hearing impaired; two were hard of hearing. Twelve of the students used manual communication; two used voice and lip reading (they did not know sign language). The students ranged in age from 13 to 19. The majority were between 14 and 16. Eight of the students were preparing to enter the 8th or 9th grade in high school; the other six were preparing to enter the 10th or 11th grades. The students represented ten different states from California to New York, and as far south as Florida.

The staff in 1989 consisted of the project director (who also functioned as an instructor), four instructors, two interpreters, a student assistant and an evaluator. The nonacademic staff consisted of a head counselor and four dorm counselors. Additional persons served as guest lecturers on specific topics. One interpreter was only there for the last two weeks. Another interpreter had been hired for the first two weeks but was unable to come due to illness. All the staff except the student assistant were hearing. The interpreters and all but one of the counselors could sign. Nineteen students began the second year program, however, one was sent home for discipline problems during the first week. Therefore, the results for 1989 are based on the 18 students who completed the program. The participants consisted of 7 males and 11 females with average age of 14.9 years (range = 13 to 17). Seven of the students were preparing to enter the 8th or 9th grades and the other 11 were preparing to enter the 10th or 11th grades. Seventeen of the students were profoundly or severely hearing impaired and one was hard of hearing. Sixteen of the eighteen students used manual communication; two relied on voice and lip reading (one did not know sign language). The students came from thirteen different states from all across the country.

Data analysis. Data analysis involved calculation of descriptive statistics for background information and quantitative perception data. Inferential statistics were used with the pre- and post-attitude data. Content analysis was used to analyze the interview and field notes (Goetz & LeCompte, 1984; Patton, 1980). The notes were entered in dBase III using the general categories that had been established with the interview guides. These were then printed out and read in great detail for identifying emerging categories and relationships among the categories. Recurring themes and patterns were identified and form the basis of the results presented in the next section.

Results

The results are organized based on the project objectives of examining elements that impacted on its success. Many of these issues were identified by the evaluator and project manage prior to the program. However, salient issues were allowed to emerge from the data as is recommended in qualitative studies (Goetz & LeCompte, 1984). Data are reported for the following topics: recruitment and selection, instructional methods, affective objectives, project management and staffing, and adequacy of the facilities.

Recruitment and Selection

Recruitment strategies. Recruitment in 1989 began the first week of March, a month and a half earlier than in 1988. Science teachers at each school of the deaf were sent a packet of information about the program. School systems in major metropolitan areas on the east and west coasts were contacted by means of over 1,000 letters that were sent to the hearing impaired program coordinator in big school systems. The packet included flyers, 3-5 brochures, and application packets. Articles appeared in newspapers in West Virginia and major cities on the east coast. Also, 12 to 15 newsletters for the deaf carried stories about the program. There was no screening for gifted or high potential students. All students who applied were accepted.

Student characteristics. With a longer recruitment time, more students attended the program in 1989 than in 1988 (19 vs. 14). In both years, the students were a very heterogeneous group which is to be expected as the hearing impaired population is very heterogeneous in terms of preferred mode of communication, skill in manual communication, lip reading ability, degree of hearing loss, and reading level. The students' ability levels and interest in science varied, although the instructors agreed that the range of ability was less heterogeneous in the second year than in the first. While some students had trouble with the material and others clearly excelled, there were no students in the second year who were "completely out of their league".

In initial interviews, most of the students expressed a very positive attitude about coming to the camp and learning more about marine science. Exemplary comments include:

"I am really excited. I love anything to do with the ocean and SCUBA. I want to look at different kinds of marine life. Go on boat rides. The captain will give lectures about what we see -- seaweed, crabs..."

"I am interested to learn about the ocean. Very interested in science. May want to become a scientist and set up a camp like this. Love science. Science is fun."

The students who were not quite as positive expressed their feelings this way:

"My mother asked me to. I expect to have fun. I've been to camp before just to swim and play ball. No work. Suffer through the work here."

"Be more independent from my parents."

Students were also asked about their background and interest in science in terms of the types of science classes they have taken and if they read about science or watched science programs on TV. Most of the students expressed a strong background and interest in science. For example:

"I studied life sciences and have a lot of ocean books and fish books. I go SCUBA diving. I'm interested in medical science. Want to study chemistry and medicine. We have a lab in school. We dissect things. We study animals. Fun for me. I watch science on TV sometimes. Discovery and National Geographic. I have books on fishes and plant life. I read Discovery and National Geographic."

A less enthusiastic student commented:

"I will take biology freshman year. About half interested [in science], half not. Watch TV sometimes, read in the library if I have to do a report."

Effectiveness of selection process. The criteria of recruiting middle or early high school hearing impaired students on a national basis was fulfilled. While not all the students could be characterized as high ability, the range of abilities was less in 1989 than in 1988. One staff member compared the students from the first year to the second year as follows: "Better than last year. We got better quality students. Students' ages are a little older. Students are more serious about it."

One staff member brought up the issue of the number of deaf

students and appropriate recruitment techniques, as follows:

"I am not sure there is enough demand for the program. We should be able to get more than 20 to 22 students. Could be there is a need for word to get around. How do you set up that network? We don't seem to get the students interested. If we had 30 to 40 students, we would need to split it into two 2-week sessions." Small class size with this population is essential.

Instructional Methods

Instructional techniques. The instructors used a combination of lectures, lab, and field work. Lectures ranged from about 20 minutes to 50 minutes each. Field work made up between 40 to 50% of the program. The instructors used creative teaching techniques that involved the inquiry approach, small group activities, and active learning exercises. One instructor commented: "They spend about 40% of the time in the field. They spent about half their time doing experiments then they have free time."

The inquiry approach was used to teach the topic of the scientific method with the instructor asking such questions as: "What do we mean by the scientific method? What do you think is the first thing you come up with in the scientific method? Give me an example of a question from the people in this room. What can we put in there that would make it a better statement?" After the students had established a research question of "Are boys taller than girls on the average?", they decided how to collect the data necessary to answer it. They then did the calculations and answered the question. The instructor then asked the students to go outside and pick a research question and collect data to answer it. The students went outside and stood around. Another signing instructor went around asking the students if they knew what to do. After twenty minutes, the students were told to come back inside and a different approach was used to finish the lesson. The students are divided into boys and girls and told to pick a question, make a hypothesis and collect data to answer it. The students did this successfully and then they were told to select their own question and hypothesis and collect data.

Other instructional techniques that were used included: flying paper airplanes with paper clips attached in different places on the plane to investigate the concept of variables in research; putting marbles in milk cartons in water to discover what makes a boat float or sink; going on boat rides to collect specimens and study the physical aspects of the sea; watching movies and slide shows; going on field trips to collect plants and animals from the water, beach, dunes, marsh and maritime forest; and role playing the food chain with students assuming the roles of sharks, squid, herring, killifish, and zooplankton. A guest lecturer also made a presentation about careers in oceanography.

Teaching materials. The print materials consisted of three books: a text entitled Oceanography and our Future by Oxenhorn and Goldfeld, and a 140 page lab book and a 66 page field guide that were developed especially for this program. In addition, the students had access to a library of approximately 100 books on marine science subjects and over 50 brochures on such topics as "Mammals, Reptiles, and Amphibians in the Chincoteague National Wildlife Refuge" and "Protecting the Piping Plover". Most of the students agreed that the text and lab books were easy to understand. Their comments indicated that it was at about the right level: "Some easy, some hard. Ocean book is a science book. It's good." "The book tells about the ocean and marsh, what's happened in the past to the future. Not really easy. Have to study for the tests. Some hard; some easy. Depends on language. Lab book have to do what you are told." The instructors agreed that the lab book was really good, well focused and sequenced. One instructor noted a needed change in the definition of plankton in the lab book.

They also agreed that changes would be needed for the field guide. The guide is in black and white and it is hard to identify the animals from the pictures. Also, some of language is difficult for this audience (e.g., one bird is identified as having "obscure streaking".)

Student response. The students were asked to describe what life was like at the camp. Their responses reveal what the typical structure of a day was like:

"Usually we have class from 9 to 11:30. Then break to do what we want till lunch. Then class until 4. Free time 4 to 5:15, then dinner. Six to 9 we have class again. Nine to 10 free. Ten to 11 study time. Eleven bed. We take trips to the marsh and beach. Do some fun things....We complain about class, but probably have fun at beach."

"Tell you what we do. Do own research project. Beginning of the day, we start class; do boat trips, collect animals and plants; throw out the net and go to the beach and swim. Go to Wallops Island and do experiments. The teachers explain before we go what we'll be doing. I understand some and some I don't understand. I read and use a dictionary."

When asked specifically what they liked about the program, many of the students responded that they liked aspects of the academic program. Most preferred going on field trips to staying in the classroom. They commented:

"I learned about the scientific method before, but didn't understand fully what it was for. Now I've done it myself. I understand."

"I am curious about my research project. That's what I liked the most. The times we would go on boat trips or go to the beach to do some experiments. All the fun was in the ocean mostly and learning how to do your own research project. Marsh was fun except for the muddy clothes every time you came back!"

Staff perceptions of strengths and weaknesses. The staff identified a number of strengths in the academic program. The balance between field and classroom time was seen as a strength. The students were able to do real research and present it to the staff and other students. One staff member commented: "In all, I was very impressed with the program. There was so much hands on, exactly what these students need to comprehend the subject area. I also feel that this program made a lasting impression on some of the students that they may consider going into a science related field." Another commented: "Hands-on experiences, a world of experience the kids wouldn't normally be exposed to. Encouragement to set high goals for themselves and to work to achieve them." Another said: "I like a lot of things - for kids to have an opportunity to hold organisms in the field. I like that. That alone isn't what we want to be doing. It has to be reinforced. I like to teach. Teach them here then let them have a personal experience."

The staff recommended a number of changes in the academic program. During 1989 access to Wallops Island was prohibited during the third week of the program because of visiting Russians. This resulted in a need to re-arrange the teaching schedule at the last minute. Therefore, one staff member commented, "Assurance that we can use Wallops Island for the entire program. The one week prohibition on Wallops hurt the planning and jammed too much academics into the last week." This re-scheduling also meant that students who needed to collect data on Wallops for their research projects had to compress their activities. Consequently, field trips were hastily arranged for these students, while the other students sat in the classroom for two days and played cards and talked.

Other recommended changes included:
-Revise the field guide
-Strengthen the chemistry part of the program
-Divide students between instructors for their research projects. Let each instructor be in charge of 3 or 4 students.
-Start class on time. Be prepared and ready to go.
-Make the program more challenging.
-Less lecture when presenting new information.
-Greater variation of activities to help hold attention.

Originally, the students were divided into three groups for their research projects. However, problems arose because the students would receive conflicting advice from the different instructors. One staff member explained: "In regards to research

projects, I felt it was hard on the students having three different staff members correcting and changing their reports. The students were constantly rewriting and changing depending on which staff member they showed their report to. I feel in the future, one staff member should be assigned to so many students and only that one staff member can comment on that student's paper."

Several instructors raised the question as to whether the students were being pushed too hard by having classes all day and into the night. One commented: "You have to remember these are children. You can only push them so far and trying to get it all in may be too much." Another commented: "We go out on the boat all day and we have class in the evening. You put in a 12 hour day, it's hot and sticky. You need to ease up on the kids. They're closing Wallops Island so we have a field trip and a boat trip the next day. The kids get grumpy. You have to pay attention. If you want to stimulate kids to be scientists, they need free time to play around. You won't do it with a 12 hour day. Definitely should not be night classes. Structured too much. Not so important to give so many facts. Just let them go out and play and feel the animals...I can't see NSF requires so much. Why not take the kids up to Wallops Island and just beach comb. Then the next day build on it. Tell them to pick things you like, not overly academic."

Several creative ideas were suggested for additional or different academic activities. One instructor suggested: "Use a beach scavenger hunt as an orientation activity. Tell the students to collect all the things that you can find and then we'll get together and talk about it. It's casual and fun and studious. Have a sand castle contest. Before or during the hunt. There is a unique geology in the beach - layers - can pick up anaerobic bacteria (black zone) - high energy, thick sediments from a storm. After they're done, judge the castles, everyone gets a prize. A good follow-up lecture about the food web and food chain could be done in groups. They could develop a food web using the specimens they collected." Another suggestion centered on making use of the natural resources in the area: "Go around three mile drive with a checklist and use the field manual."

Topics covered. The instructional program included a unit on the scientific method, boats, transect of a barrier island, oceanographic equipment and measurements, marine plants and animals, oceanography as a career, physical and chemical characteristics of water, the ethics of science, and marine biology.

Affective Objectives

Worthwhile to students. All but two of the students agreed that the experience had been worthwhile. They commented:

"Yes. I learned a lot. I'll tell my friends to come here. It's fun. You'll learn something. People are trying to save the marsh and oceans. We have to help the nation save something. Tell Congress to save the marsh. I never thought about it but they told us about it. We should save it. There are only a few marshes in the world."

"Yes. I think it is interesting. I have a chance to know what nature was like before and in the future. People only think about money. Nature will disappear. Value of nature; miracle how nature is beautiful."

One negative comment related to an inability to understand what was taught:

"No. Because it has been...hard for me to explain...I haven't learned what I wanted. For my learning, it is hard for me to learn about biology. Hard language for me. I feel I didn't want to ask teacher to keep repeating. I didn't want to be embarrassed."

Challenge/bored. The staff recognized that some of the students were challenged and some were bored. Some were not challenged because they wanted more in-depth, higher level material and some were not challenged because they were bored with the "school-like" atmosphere and just wanted to have fun. Two exceptionally bright students commented:

"I think the work is too easy for me because I like challenges and there were no challenges here. Next year I hope there will be more challenges."

"I feel that the work here is too easy. And there is no challenges for me. I want a lot of challenges."

Other students commented:

"Challenged by things I do physically. Boring is lectures. Lectures are too long."

"Varies. Bored in lecture. Challenge ask me to help. Makes me think. Cut lectures down. Challenge to teach others. I learned a lot from my own research project. It helped me a lot of understanding about animals ways. I would recommend to my friends to come here and learn."

"Bored. Don't understand lecture because of interpreter. Understand activities. Lectures are too long."

"Yes. When I understand something more complex, I feel challenged."

Attitudes toward marine science and science in general.

Student attitudes toward marine science were measured by pre- and post-tests and the results for 1989 are presented in Table 1. The ratings were made on a 1 to 5 scale, with 1 representing the negative end of the scale and 5 representing the positive end. On the pre-test, student attitudes were uniformly positive toward marine science (ranging between 3.0 and 4.7). Attitudes were lowest concerning the students desire to teach marine science (3.0) and what the students already knew about marine science (3.2). On the post-test, desire to teach marine science rose slightly, but it was still the lowest rated item (3.3). Nine of the scales increased from pre- to post-tests and one stayed the same. The decrease observed on three of the scales can be explained by the ceiling effect on the marine science instrument. The students were "hitting the ceiling" on the pretest, therefore, it is not surprising to see a slight decline on the post-test. All post-test scores were in the positive range (3.3 to 4.7).

Students were also asked on a post-test to rate the impact of the program on their attitudes toward science in general and their feelings of their own capabilities. The results for 1989 are presented in Table 2. The rating was made on a 5-point scale with 1 representing no impact and 5 representing high impact. All the ratings were well-above the neutral mid-point and ranged from 3.50 to 4.50. On another 4-point scale, students were asked to strongly agree (4) to strongly disagree (1) with a series of statements concerning the impact of the program on their interest in science. Again, their ratings were above average, ranging from 2.61 to 3.50. While these data do not offer definitive evidence of the effectiveness of the program they are consistent with the other attitudinal data and support the conclusion that the students viewed the program in a positive light and felt that it had a positive impact on them.

Career awareness. The students were quite variable in terms of their career aspirations. They mentioned such career areas as architecture, business, wrestling (for the money), and cashiering (because it was hard for her to learn things). Four students were very certain that they want to become marine scientists. One commented: "An oceanographer. I want to be a scientist. I can see my own office with my name on the door -- Dr. _____." One student who chose chemistry and medicine as a career expressed a very pragmatic attitude: "Chemistry and medicine. Marine science makes me happy, but chemistry and medicine would be for a job." Other students indicated an interest in science-related fields also such as science or math teacher, veterinarian, and nurse. One student changed her original career goal from wanting to become a science teacher to wanting to become a scientist by the end of the program. She said: "Maybe I can discover something new. Like plants and medicine. Instead of being a science teacher, I want to be a scientist. Maybe a researcher, I don't know, something with biology."

Comparison of pre and post career objectives indicated very little change. The students did increase their knowledge about what marine scientists do and how much education is needed to become a scientist. It is probably unrealistic to look for dramatic shifts in career aspirations in a group of young people during a four-week summer program. If students are selected on the basis of their interest in science, then this may demonstrate the self-fulfilling prophecy. The impact of the program on career decisions cannot really be measured until these young people have entered college, chosen majors, and entered the job market. Many complex variables will have interacted to produce the youngsters' final career decision.

Project Management and Staffing

Expectations and motivations. Three issues emerged from the data concerning staff expectations and motivation. First, the staff who returned from the first year expected that things would be better this year. One commented, "I expect it will run smoother and proceed better. I assume problems are taken care of." By the end of the first year, seven of the staff who were on-site agreed (independently) that they would not return the next year unless significant changes occurred. Another returning staff member recognized some of the immediate changes: "We have a better group of students. We made real strides in planning and staffing. The schedule for the first week is already done." Second, the academic staff expressed an interest in "turning on" the students to science and to transferring what they learned to their home institution. They commented:

"I have been involved with this kind of thing before. It is a beautiful experience. I know what they'll get here will be powerful in depth. I expect to have an enjoyable time to instruct students on the interrelationships that exist; organisms that live here and develop an appreciation for what they see here."

The third issue relates to staff knowing what is expected of them in their jobs. In the beginning, one non-academic staff member explained his expectations as: "I expect I will do a lot of supervision of kids; participate in field experiences. Do a little interpreting, provide activities in the evening hours. Generally, we'll be free from around 9 to 4 or 5 except on field experiences. We'll be rotating for interpreting."

Project Management: Scheduling and Staff Involvement. Staff members raised several issues concerning project management, scheduling, and involvement of staff in decision making. First, several of the returning academic staff members commented that the scheduling and organization were better than in 1988. Staff meetings were held weekly to develop schedules that were posted on Friday. Despite this process, the staff felt there was still room for improvement in this area. The academic staff did have some

time off in 1989, however, it was an afternoon here or an evening there. One instructor felt that they should have two designated days off each week. The nonacademic staff did have two days off a week, however, they still found problems with the scheduling. For example, one commented:

"We need better organization and communication so that each staff knows when he or she will be in charge and what to do. The academic staff also. There were times when the dorm staff was supposed to be off, but the person in charge of the academic program never showed up leaving the dorm staff stuck. Also, make sure academic duties are fairly assigned. It seemed that some were always working all day, others half days and taking whole days off."

A second issue related to the lines of authority for disciplining students. If a discipline problem occurred in a nonacademic setting, it was referred to the head counselor and then to the project director. Discipline problems in the classroom were to be referred to the project director. Both academic and nonacademic staff recommended changing this system to place more authority in the hands of the instructors and counselors. One commented:

"Leave dorm discipline more in the hands of the counseling staff. This year, they paid us to be babysitters. It was demeaning to us to have to hand every small problem over or ask permission to discipline...If he (the project director) was planning to handle all the discipline, why did he waste his money on us? We had no authority in the kids' eyes, so they felt they didn't need to do as we asked."

Third, a mechanism was established for student complaints to be brought to the director's attention. The students were dissatisfied with the role of the interpreters and with one of the interpreter's sign skills (especially receptive skills). The director established a Student Council and the students elected representatives to bring the problem to the director.

Fourth, several of the staff asked for feedback to let them know how they were doing on their jobs. The project director attempted to meet with the staff to give them feedback, but ran out of time, so everyone did not get feedback during the program.

Fifth, staff felt like they had a clearer idea of what was expected of them in the second year. However, the nonacademic staff felt that it would be helpful to have a set of guidelines that would make their responsibilities even more explicit. The following recommendations explain their feelings:

"Make it more clear to staff what is expected of them. What time to be on duty? What are your discipline philosophies? How much

freedom do you want the kids to have? Do all counselors need to be on duty at all times? Or, may we take shifts with only one staff on at times? How closely should we supervise? These were a few of the questions that were never clearly answered."

"Need better organization and communication. We need to know more what we are expected to do. We didn't know that we were supposed to sit with the kids in the cafeteria. Are we supposed to supervise kids in the dorm every minute? Are we on duty all the time?"

"We need a staff manual - not just the rules. Things like can the kids leave the cafeteria and go for a walk around campus without telling the counselors? Is the eleven o'clock lights-out flexible? On field trips, kids need partners. Who is responsible at lunch time? Are counselors responsible at all meal times? If all four are gone, will the instructional staff be in charge? Need to explain that."

Knowledge of science/teaching. The academic staff had excellent credentials in science and teaching. Two instructors were college professors in biology, one was a high school science teacher, and one a science teacher in middle school. One instructor was a naturalist with seven years of experience at various national parks and six years experience at Wallops Island. The interpreters were also science teachers in middle schools.

Knowledge of deafness. In 1989, the nonacademic staff (with one exception) worked at a residential school for the deaf. One of the instructors was deaf and taught at a residential school for the deaf. The student assistant was deaf also. One of the interpreters taught at a residential school for the deaf. These staff members with extensive experience with deaf students felt that the staff without such experience (i.e., the other academic staff members in both 1988 and 1989) would benefit from taking a course in the psychology of deafness. In 1988, the nonacademic staff (other than the deaf student assistant and the deaf counselor who left after the first week) were unacquainted with sign language or deafness.

On a related point, several staff members felt there should be a greater involvement of deaf professionals. One suggested: "We need deaf role models. The students need to see and talk to a real deaf scientist. It does not have to be a marine scientist." Another commented: "It is necessary to have one deaf teacher as a role model...The more I think about this program, it should be done by Gallaudet. We don't really have the expertise. It should be run by the deaf."

Three other issues relate to knowledge about deafness. One concerns the physical set up of the classroom or the arrangement

of students during teaching in the field. At the beginning of the program, the tables in the classroom were arranged in rows (like in a typical "hearing" classroom.) The students told the staff that they should be arranged in a semi-circle. This change was made in the first week. In the field, one instructor suggested that "the hemisphere be strictly enforced. We should lay down guidelines for the staff. This is how we run a field trip. We have a hemisphere of students with the teacher and the interpreter in the front. The counselor should stand behind the group. Draw a circle in the sand with half of it for me and the interpreter and the other half for the students."

The second issue related to deaf awareness is the use of notetakers in the classes. One instructor felt that providing notetakers to the deaf students would be "coddling them". The decision to use notetakers really should rest on how much of the information that is presented is in the book or in printed materials that the students have. If notetakers are not provided, then the instructors must realize that the deaf students cannot watch them and write notes at the same time. If the students are expected to take notes, then the instructor must stop and allow them to write, and then continue.

The third issue reflects the heterogeneity of the deaf population. The one girl who could not sign felt like the other kids were making fun of her and at one point she started crying in her interview with the evaluator and said she wished she was at home with hearing kids who didn't make fun of her. The staff needs to be aware that differences in communication mode can have emotional effects and be sensitive to students who encounter these problems.

Ability to interact with young people. The academic staff did not feel that they had developed a close relationship with any of the students. They felt that perhaps the committee approach to the research projects had diluted the individual relationships that might have developed. The students were asked to name their favorite teacher and they mentioned each teaching staff member at least once. The counselors felt like they had developed closer relationships with the students than the instructors did.

Behavior management. Students and staff agreed that changes were needed in the discipline policy and practice. One student commented, "We need someone to make sure some kids need to pay attention." Another said, "There should be no talking in class, no horse play until break time - 15 minutes or less." The academic and nonacademic staff members complained that the discipline was lax and inconsistent. One instructor commented:
"Program itself is good if the kids paid attention and discipline was better, it'd be better. We do have a discipline problem that could be corrected. During class time they must watch me. It not, then they must come back and work on a separate report. They

should not make smart comments."

She then recommended that the following academic discipline rules be established:

1. Pay attention at all times when an instructor or interpreter is talking to the group in class or on a field trip.

2. Do not be interrupting in class by talking to the person next to you.

3. If you have a question, ask one of the instructors or interpreter, not another student.

4. If you want to make a comment during a discussion, please do so but make sure it's not a smart comment.

"Have consequences for breaking the rules. You know the rules, you must obey them while you're here. If you choose not to, here are the consequences: You will not be permitted to participate in dorm activities after supper. Instead you will be given a book to read in which you will be required to write a one page or more report, or you will be given a separate research project (not the one you choose for your research) to work on."

The nonacademic staff also recommended stricter and more consistent discipline. One counselor recommended the following rules:

1. Never leave designated areas without staff person approval (instead of now we say that only when you're at the beach.)

2. Obey counselor on first request at all times (Now this is only at the beach).

3. Respect other students - this covers loud noises, arguments, not really in the rules now and should be there.

4. Appropriate play only in appropriate areas (no basketball in the lab; no wrestling in the dorm).

5. Students should respect counselors (e.g. no talking back, knock on counselor's door before entering).

Both academic and nonacademic staff agreed that consistent consequences must be attached to not following the rules. In the classroom, students were sleeping, playing cards, writing letters, talking to each other, and generally not paying attention. Part of the reason for this behavior was the lack of enforcement of discipline rules. Another reason relates to the staff's ability to use sign language and the role of the interpreter.

Sign language and role of the interpreter. Everyone agreed

that having signing counselors was an improvement in 1989 program. One staff member commented: "A lot better this year, biggest changes are the counselors are used to working with deaf kids and can sign and know about deafness. They are real good."

The students were dissatisfied with the interpreters for three reasons. First, they felt that one of the interpreters did not have adequate receptive skills thus forcing them to have to repeat themselves and that he still did not tell the instructor everything that they said. Exemplary comments include: "Interpreter is lousy. Refuses to interpret to teacher what I say." "Better interpreter needed. Boring. Repeat. Repeat. Repeat." Second, several of the students requested interpreters who could sign ASL. This does present a dilemma in that many of the students came from mainstreamed schools and did not use ASL. The expense of having two interpreters is prohibitive. This is another example of the complexity of the heterogeneity of the deaf population.

The students' third concern centered on the role of the interpreter. Traditionally, interpreters only convey the information that the speaker says. However, in this setting, the interpreters were assisting in the discipline of the students and providing clarifying comments when they felt the students were not understanding. One student commented: "Interpreter is supposed to copy the teacher, not tell other kids what to do." However, the interpreter felt that the four-week workshop environment is not the same as a classroom and roles may need to be modified to adapt to the unique demands of the situation. The interpreter commented: "It's not a typical role as an interpreter. It can't be like that. A regular interpreter would not take the hours and length of sessions; not here for a month." She felt that it was appropriate for her to tell kids to pay attention. She said: "The kids should all be paying attention. I'm a teacher, so I tell the kids to pay attention. One kid says, 'You're only the interpreter, you're not supposed to do that'." She made the following recommendation:

"Specific rules for students' classroom and dorm time behavior should be covered at the start, as well as specifying who is responsible for enforcing them, especially during classroom time. Instructors should agree on the same behavior standards and if it is so decided, interpreters will have the same authority and responsibility for enforcement."

Also, the difficulty level of the material being presented and the instructors lack of experience in teaching deaf students caused a problem for the interpreters. One interpreter said, "If I think they don't understand, I say do you mind if I stop you. Then if the language is too difficult, I say, 'You'll have to use a different word or explain that'." She recommended that the staff sit down and discuss the role of the interpreter and clarify what is appropriate.

A number of other issues concerning sign language were raised. People from different parts of the country have regional signs. There may be ten different signs for the same concept. This emphasizes the necessity for agreeing on what the signs will be and for spelling any technical word first and then showing the students the sign for that word.

Recreation. The recreational activities were viewed very positively by everyone. Staff commented: "Well organized and planned in advance." "Different, fun. Students enjoyed student/staff volleyball and Russian-American basketball best. Several kids enjoyed the roller skating also." The students commented that they liked the recreational activities -- their only complaint was that they wanted more of them.

Several recommendations were made for changes to the nonacademic program, such as: setting aside a room as a student lounge, putting in an outdoor basketball court on the Consortium grounds, going out to the movies, more free time, go to more attractions in the area (like AEGIS), go to the mall, more shopping, bowling, miniature golf, flag football, soccer, softball, swimming in a pool, going for more walks, wrestling tournament, going to the beach more, taking naps, new games, UNO cards, and art classes at night.

Interaction with fellow staff members. The staff worked together very well. They commented: "I believe everyone did a good job (except one). I would like to see the same staff back next year. Academic and counseling worked well together." "Wonderful! The counselors all could sign (unlike last year) and worked well together. The academic staff was well prepared and friendly and worked well together. I felt there was a very good group of people working together this year."

Some discussion centered on ways to screen staff better. One staff member suggested: "I would always get a second if not a third opinion on staff (including assistants) even if I trusted that person." Another suggested: "Go through area communications centers for more interpreter applicants. Don't hire only interpreters who know science."

Adequacy of the facilities

The feelings about the facilities could be summed up by this comment: "This is about as good as could be expected for such a program. Obviously it isn't home, but you shouldn't expect a 'camp' to be like home." Recommendations for improvements included:

-Install an audio loop for hard of hearing kids
-Get staff refrigerators
-New equipment for the lab: aquarium equipment, air blower,

power cleaner
-Improve the quality and variety of food
-Central air in the classroom (could this be donated by a big company?)
-Tell kids to bring fans
-Captioning on the films
-More doors on the girls' side
-A martin bird house to eat the mosquitoes
-Infirmary based at the consortium with a 24-hour nurse
-Vans and buses in good working order (Would Greyhound donate a bus?)
-Cleaner rooms and bathrooms
-Get rid of bugs
-More microscopes in the lab
-Closed caption TV
-New tables in lab
-Ceiling fans in dorms

SUMMARY AND IMPLICATIONS

Generally, the students' affective response to the program was positive. All but one student would recommend the program to a friend as long as their friends liked marine science and were not stupid or lazy. The academic and nonacademic programs were both considered to be very strong. The students and staff made many recommendations for improving the program. Their comments form the basis for the following guidelines:

Recruitment

1. Start recruitment early. The first week of March is appropriate for a program in July.

2. Use multiple materials and methods. Materials include flyers, brochures, application packets and videotapes. Methods include contacting schools for the deaf and coordinators of hearing impaired programs in major cities, placing articles in newspapers in major cities and newsletters for the deaf community, and using previous year's students to describe their experiences in their home schools.

3. Build a network among the schools participating.

4. Expect heterogeneity in the students recruited in terms of preferred mode of communication, skills in manual communication, lip reading and vocalization abilities, reading levels, motivation for attending, and background in science.

Instructional Process

1. Use active-learning exercises. For example, in teaching the

scientific method use the inquiry approach to develop and test a simple hypothesis as a class. Then have the students work in teams repeating the exercise and finally do it themselves. The Marine Science program included many fine examples of active learning techniques such as role plays, conducting simple experiments with paper airplanes, sinking boats made of milk cartons, and collecting specimens on boat trips.

2. Use small group exercises. Incorporate cooperative learning strategies into lessons. Allow faster students to tutor slower ones.

3. Build assessment into lessons to give feedback to teachers and students.

4. Develop back-up plans in case weather or administrative changes prevent implementation of original plans.

5. Meet the individual needs of the students. Design enrichment activities for brighter students. Arrange for tutoring for slower students.

6. Combine lecture, lab and field work. Keep students in the field approximately 50% of the time.

7. Start classes on time.

8. Allow free time for thinking and playing.

9. Keep lectures short (10 - 20 minutes) with frequent breaks.

10. Capitalize on the natural resources in the area (e.g. the ocean, beach, dunes, marsh, and maritime forest).

11. Assign homework to the students.

12. Have a text, lab book, and field guide written at the appropriate level (about sixth grade).

13. Begin each lesson by establishing the technical vocabulary first.

14. Emphasize positive attitudes toward science and ethical responsibility.

15. Keep the day a reasonable length. Avoid night classes.

16. Arrange for a mentor for each student to work on their research projects independently.

17. Wait a full five second count after asking a question for the question to be interpreted to those students who rely on the

interpreter and for the students to have some processing time.

Project Management and Staffing

1. Make a schedule of academic and nonacademic activities weekly. Have it available several days before it is to go into effect. Be sure everyone understands that changes may occur and they need to be flexible.

2. Involve staff in decision making through weekly (or more frequently, if needed) staff meetings.

3. Be sure academic staff are knowledgeable about science and the natural resources in the area.

4. Be sure academic staff are knowledgeable about appropriate teaching techniques for teaching hearing impaired adolescents.

5. Be sure dorm counselors (nonacademic staff) can sign.

6. Be sure interpreters are skilled in both expressive and receptive signing. Address the issue of preferred mode of communication. For oral deaf students, be sure they sit in front of the teachers so they can see their lips. Address the issue of ASL vs. signed English. Determine the appropriate role of the interpreter concerning clarifying concepts and disciplining students. Be sure interpreter signs and voices student questions and comments.

7. Have interpreters agree on one sign when regional signs exist for concepts. Spell the word first, then sign it.

8. Find deaf professionals to serve as role models.

9. Find highly motivated individuals who really want to work with young students.

10. Communicate specific job descriptions to the staff.

11. Give staff time-off during each day and two days each week. Inform them ahead of time when their time-off is. Rotate counseling staff to cover lunch time.

12. Specify the lines of authority for discipline. Both academic and nonacademic staff need authority to discipline.

13. Be aware of staff conflicts and their impact in a close living arrangement. Act to resolve conflicts promptly.

14. Establish a student council. Let students select representatives to bring complaints to the project director's attention.

15. Examine the need for notetakers. If the majority of the information is already in printed form in their books, then allow time for the students to write things down as needed. Realize that if they are not watching you, they don't know what you are talking about.

16. Be sensitive to the emotional impact of the heterogeneity of the group. If one student (or a few) don't share the same communication mode, are they being left out or made fun of?

17. Provide regular feedback to staff.

18. Provide guidelines to staff concerning their responsibilities and time-off.

19. Have specific rules for academic and nonacademic behavior with associated consequence that are consistently enforced.

20. Get a second or third opinion about staff before you hire them.

21. The composition of staff that worked well in the Marine Science Project with 18 students consisted of: the project director (who also served as an instructor), 4 instructors, 2 interpreters, 5 dorm counselors, a student assistant, and an evaluator. The project director needs an assistant who can also function as a handy man.

Facilities

1. Get captioned films and videotapes.

2. Arrange the room in a semi-circle so all the students can see the teacher, the interpreter and each other. Be sure this arrangement is also used on field trips. A circle can be drawn in the sand with the teacher and interpreter in one half and the students in the other.

3. Explore the possibility of corporate contributions for such large items as central air conditioning and a bus that works.

Recreational Activities

1. Need a variety of well-organized and pre-planned activities such as swimming, shopping, skating, tour of local areas, basketball, videotapes, carnivals, boat trips, volleyball and other sports and games.

2. Capitalize on what is in the area (e.g, tour of AEGIS facility, tour of the weather facility)

3. Provide a student lounge for use during free time.

Evaluation

1. Provide on-going feedback to the project director through an independent evaluator. Allow time for the evaluator to work with the staff to implement the evaluation findings.

2. Read the evaluation reports from the two years of the Marine Science Project to adapt the strengths and avoid the weaknesses (Mertens, 1988, 1989).

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Table 1

STUDENT ATTITUDES TOWARD MARINE SCIENCE (1989)

	Pretest $\bar{X}$	Post-Test $\bar{X}$
What I know about marine science (1 = nothing; 5 = a great deal)	3.2	4.3
I want to know more about marine science (1 = strongly disagree; 5 = strongly agree)	4.6	4.1
Marine science (1 = I dislike it; 5 = I like it)	4.4	4.5
Marine science (1 = has no value; 5 = is of great value)	4.3	4.4
Marine science (1 = is of no help; 5 = can help me)	4.7	4.7
Marine science (1 = is not practical; 5 = is practical)	3.8	4.6
Marine science (1 = is not fun; 5 = is fun)	4.7	4.5
Lectures (1 = I dislike them; 5 = I like them)	3.3	3.8
Laboratory work (1 = I dislike it; 5 = I like it)	4.1	4.3
Field work (1 = I dislike it; 5 = I like it)	3.7	4.2
Everyone should study marine science (Strongly disagree; 5 = strongly agree)	3.6	3.9
I would like to teach marine science (1 = not at all; 5 = very much)	3.0	3.3
I want to tell others about marine science (1 = nothing; 5 = everything)	4.1	4.6

Table 2

IMPACT OF THE PROGRAM ON STUDENT ATTITUDES (1989)

		$\bar{X}$
1.	Your curiosity about how things work.	4.4*
2.	Your interest in science.	4.5
3.	Your confidence that you could understand science.	4.3
4.	Your desire to watch programs on TV about science.	3.9
5.	The amount you want to read about science.	4.3
6.	The number of science courses you plan to take in school or college.	4.0
7.	Your ability to teach people.	3.5
8.	Your desire to work with people.	3.9
9.	Your desire to learn on your own.	4.2
10.	Your understanding of your capabilities.	4.2
11.	Your self-confidence.	4.0
12.	Participation in this project has increased my interest in science.	3.3**
13.	Participation in this project has increased my understanding of the research process.	3.3
14.	The financial aid offered me, if any, had a strong influence on my decision to participate in this project.	2.9
15.	I plan to take more math and/or science courses in the future than I had originally planned as of the end of the school year.	3.3
16.	I now understand the course requirements for majoring in science.	3.3
17.	I will recommend projects like this to friends who are interested in science or mathematics.	3.5
18.	If I had the opportunity, I would participate in a similar project.	3.1

19. Participation in this project has increased my interest in becoming a scientist 2.6

20. I spent a lot of time with the scientists in this project. 2.7

* (1 = no impact; 5 = high impact)
** (1 = strongly disagree; 4 = strongly agree)